SOME NUCLEI OF CLOUDY CONDENSATION.

By Dr. J. AITKEN.

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By means of an improved apparatus for producing a series of definite expansions of a given volume of saturated air, the author studied the cloud-producing qualities of dust particles of different sizes obtained in various ways. After the air was cleared of the largest particles by one or more applications of a 2 per cent expansion, cloud-producing particles of smaller sizes were removed in succession by expansions 4 per cent, 6 per cent, 8 per cent, and so on up to 20 per cent, if necessary. The particles were produced by such means as flames, electric sparks, chemical action, and heating of solid substances; and the general conclusion was that in no expansion lower than 25 per cent was there any evidence of electric ions being by themselves efficient nuclei for cloudy condensation. The view that the nuclei of cloudy condensation produced by heat are ions discharged at high temperatures is not supported, since such nuclei are produced at much lower temperatures than that at which ionic discharge from heated bodies occurs; and even at this higher temperature spectroscopic examination shows that some chemical or disintegrating action takes place along with the discharge of the ions.

CONDENSATION AND EVAPORATION OF GAS MOLECULES.

By I. LANGMUIR.

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Previous work by the author gave evidence that atoms of tungsten, molybdenum, or platinum vapors, striking a clean, dry glass surface in high vacuum, are condensed as solids at the first collision with the surface. Similar evidence was obtained from a study of chemical reactions in gases at low pressures. It was concluded that in general, when gas molecules strike a surface, the majority of them do not rebound from the surface by elastic collisions, but are held by cohesive forces until they evaporate from the surface. In this way a theory of adsorption was developed which has been thoroughly confirmed by later experiments, viz, the amount of material adsorbed depends on a kinetic equilibrium between the rate of condensation and the rate of evaporation from the surface. Practically every molecule striking the surface condenses (independently of the temperature), while the rate of evaporation depends on the temperature and is proportional to the fraction of the surface covered by the adsorbed material. R. W. Wood's experiments on mercury atoms impinging on a glass plate at definite temperatures are referred to and discussed, following which comes a review of Wood's experiments on a stream of cadmium atoms, which stream on striking walls of a well-exhausted glass bulb does not form a visible deposit unless the glass is at a temperature below about $-90°$C., but when started the deposit continues to grow in thickness even after it is warmed to room temperature. Wood concludes that nearly all atoms of cadmium are reflected from surfaces other than cadmium if the initial temperature is above $-90°$C. The present author criticizes this reflection theory and proposes as a better alternative the condensation-evaporation theory, and, to determine definitely which of the two theories correspond best with the facts, he has repeated Wood's experiments under modified conditions which are described at some length. The experiments prove that single cadmium atoms actually evaporate off of a glass surface at temperatures below room temperature, although they do not do so at an appreciable rate from a cadmium surface. The condensation-evaporation theory thus verified affords a very satisfactory explanation of Moser's breath-figures on glass and the peculiar effect observed in the formation of frost crystals on window-panes. The author opines his theory to be capable of extension to the whole subject of nucleus formations, including the crystallization of subcooled liquids.—*H. H. Ho[dgson.]*

[1] Proceed., Nat'l Acad. Sci., March, 1917, 3:141-147.

COMPUTATION AND MEASUREMENT OF THE COMPLEX MOLECULES OF SOME VAPORS, ACCORDING TO THE NEW CONDENSATION THEORY.[1]

By L. ANDRÉN.

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* * * The series of experiments were conducted in the absence of any electric field; with electric field up to 330 volts/cm; by increasing the never-absent radioactive radiations of the atmosphere and earth with the aid of pitchblende and of weak and strong radium preparations, first with water vapor and air. The experiments with CO_2 as gas gave much the same results. When the gas was hydrogen the results differed from those previously obtained when the small [spherical expansion chamber] was used, but agreed again when the large sphere [260 cu. cm.] was applied; ~~Wilson's~~ condensation chamber, it is pointed out, was still smaller than the author's small [60 cu. cm.] sphere. Alcohol was tried mixed with air and with hydrogen; benzene only in air mixtures. The general conclusion drawn is that the ordinary condensation by expansion depends mainly on the formation of electrically neutral complex vapor molecules and their size and surface tension, and is hence independent of the gas containing the vapors, while the electric carriers (ions) play only a secondary part. The formation of nonelectric nuclei is a function of the vapor; the presence of traces of foreign vapors has no influence, provided chemical reactions (due to radiations) be excluded; the nuclei consist hence of complex polymerized vapor molecules. In addition to these nonelectric nuclei there are electric carriers of both polarities, due to the radiations (terrestrial and atmospheric); they make up perhaps 1 per cent of the whole nuclei and consist predominantly also of vapor molecules. In size the nuclei differ with the nature of the liquid (vapor); but there is no discontinuity between the mists and the drops of a vapor, and the two types of condensation can not be differentiated by definite expansion values. The electric carriers are always the largest nuclei; their number naturally depends also on the gas; their number, 900 (no external field), would correspond to the 0.4 carriers per second per cu. cm. assumed to account for the very small residual conductivity of the air. There are, further, when the supersaturation degree is 5 or more, some very large nonelectric nuclei (0.1 per cent of total number) due to the chemical reactions caused by the terrestrial radiations (H_2O_2, O_3, etc.). By far the greater number of nonelectric nuclei are, however, small in size and consist of complexes of only a few (2 or 3) molecules; their number, deter-

[1] Ann. d. Physik, Feb. 5, 1917, 521:1-71.